Variability in Hawaiian Coral Across a Natural Range of Temperature, pH, and Flow Gradients

Alec Moore[1], Rowan McLachlan[1], Andréa Grottoli[1], Christopher Jury[2], Kerri Dobson[1], Rob Toonen[2]

[1]The Ohio State University, School of Earth Sciences, Columbus, Ohio USA

[2]The University of Hawai'i at Mānoa, Honolulu, Hawai'i USA

Introduction

Coral reefs are among the most ecologically diverse and economically important habitats on earth, yet the combined effects of ocean acidification and warming threaten the integrity of these ecosystems globally. The reefs surrounding Oahu, Hawaii provide an exceptional opportunity to survey physiological variation among coral species as they have responded to naturally occurring ocean condition gradients. Peak summer temperature and pCO_2 in Kane'ohe Bay (Sites 3&4; *see* ***1a***) mirror values that are expected to persist globally by mid-century, while other sites exhibit conditions comparable to the current global mean for tropical reefs.

We hypothesize that populations of coral can adapt to high temperature and pCO_2 conditions by adjusting aspects of their physiology that confer resilience. By comparing biomass and chlorophyll *a* from three species of coral distributed over four discrete sites**,** we seek to address the following questions:

- **Do high temp. and pCO_2 have an effect on biomass or Chl *a*?**
  - **How might this relationship be influenced by flow?**
- **What might these findings suggest for the capacity of coral to acclimate or adapt to a warm, acidic ocean?**

Methods

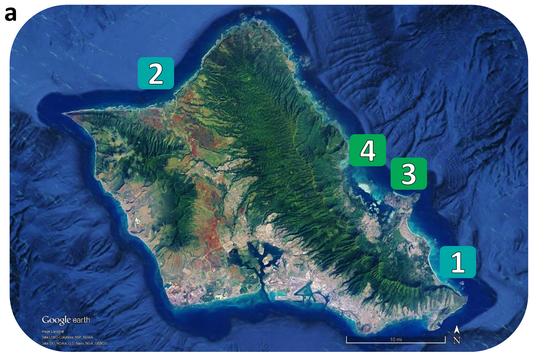
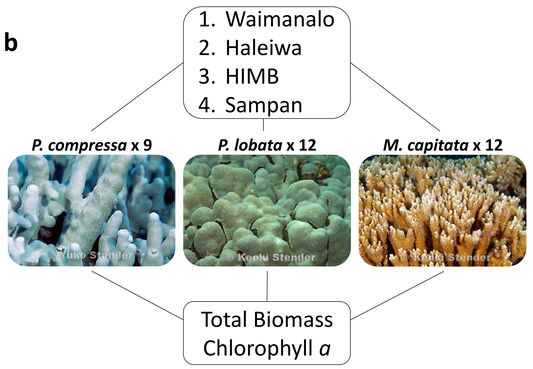


Fig 1a: The island of Oahu (HI), with each sampling location labeled numerically. *See* ***1b*** *for corresponding site name*.
Fig 1b: A diagram describing the survey design



**P. lobata* does not occur at HIMB

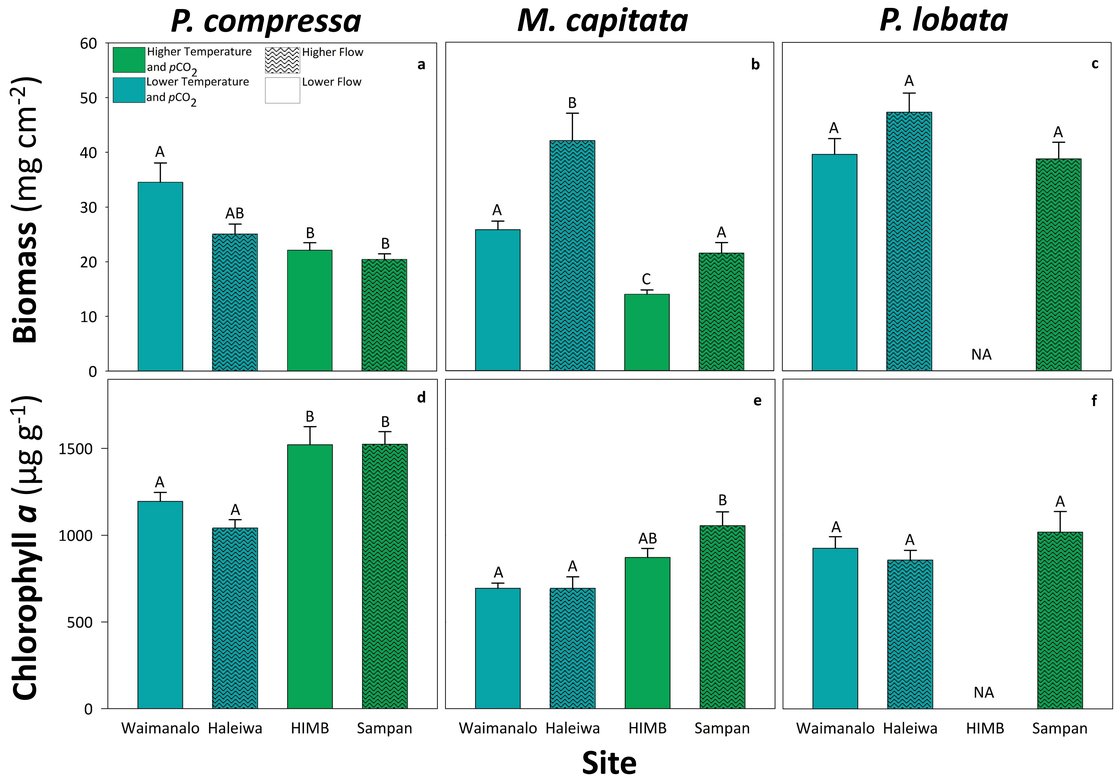


Fig 2: Mean (± 1 SE) biomass and Chl *a* measurements for, respectively, a-d) *Porites compressa,* b-e) *Montipora capitata,* and c-f) *Porites lobata*, at each reef location. Shared letters indicate no significant difference between locations.

Results

P. compressa

- On average, biomass was 27% lower and Chl *a* was 37% higher at high temp/pCO_2 sites (i.e., HIMB and Sampan) than at the other two sites
- Flow did not significantly effect biomass or Chl *a* at any location

M. capitata

- On average, biomass was 48% lower and Chl *a* was 28% higher at high temp/pCO_2 sites (i.e., HIMB and Sampan) than at the other two sites
- Biomass was higher at high flow sites (i.e., Haleiwa vs Waimanalo, and Sampan vs HIMB) within each temp/pCO_2 group.
- Flow did not significantly effect Chl *a*

P. lobata

- No significant differences in biomass or Chl *a* were found across locations
- Flow did not significantly effect biomass or Chl *a* at any location

Discussion

- ***M. capitata* and *P. compressa* biomass was lower and Chl *a* higher in Kaneohe Bay** (i.e., HIMB and Sampan) **where temperature and pCO_2 are higher than at the other two sites.**
- **Neither of these patterns were observed in *P. lobata*.**
  - These findings suggest that morphology may influence resilience, as the former two species are branching, while the latter is mounding.
- **The extent to which temperature, pCO_2, and flow effected biomass and Chl *a* varied between species**.
  - A suite of other physiological parameters will be assessed for the larger study, which are expected to provide a more robust understanding of how these environmental conditions effect Hawaiian coral species.
- **Flow appears to minimize the negative effect of elevated temperature and pCO_2 on *M. capitata*.**
  - This suggests that reef sites with higher flow may provide refugia for some corals species.

Acknowledgements

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